Surface Atmospheric Circulation Over Europe Following Major Volcanic Eruptions, 1780-1995

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Major volcanic eruptions are identified among the external forcing factors responsible for the natural variability of climate. It is well known that aerosols injected into the lower stratosphere by explosive eruptions cause stratospheric warming and cooling at the surface from 1 to 2 years following the event, due to reduction of incoming solar radiation. The well-documented eruption of Mt. Pinatubo (June, 1991) brought more light to the climate effects of large volcanic eruptions. Actually, within the IPCC Third Assessment Report, these effects are reported as an important forcing factor to be taken into account. In spite of this global impact, there is increasing evidence that there may be seasonal differences in the response of the climate system. Volcanic aerosols heating the tropical lower stratosphere produce a perturbation of the temperature gradient, resulting in an enhanced North Polar vortex in the lower stratosphere and strengthening of the westerlies in the winter (and strengthening of North Atlantic Oscillation, NAO pattern). In this paper we use the monthly mean pressure reconstructions for Europe developed by Jones et al. (1999). Data set extends from 1780 to 1995 on a 5§ latitude by a 10§ longitude grid, encompassing the region 70§N-20§W to 35§N-40§E. According to the data set used, eight large equatorial volcanic eruptions are selected, namely: unknown (1809), Tambora (1815), Cosiguina (1835), Cotopaxi-Awu (1856), Krakatau (1883), Santa Mar¡a (1902), El Chich¢n (1982) and Pinatubo (1991). In order to detect circulation anomalies after such events, principal component analysis (PCA) is applied. For every month it is possible to reconstruct the original field by the mean and the first few principal components (PC's). By means of this technique, the main goals of the investigation are achieved: firstly, identifying the main monthly circulation types over Europe (explaining most of the variability), and secondly, detecting possible changes in the weight or distribution of the different circulation types during the months following major volcanic eruptions. Ref.: Jones et

al. (1999): 'Monthly mean pressure reconstructions for Europe for the 1780-1995 period', Int. J. Climatol., 19: 347-364.